

- 24 -

Claims

1. A method for fabricating a micro-sensor device comprising the steps of
  - (i) fabricating on a parent substrate (10) at least one sensor element (21),
  - (ii) forming an interconnect layer (32) having first and second surfaces remotely to the parent substrate (10) so as to enclose the at least one sensor element (21) between the first surface and the parent substrate,
  - (iii) providing a plurality of electrical interconnections (33) between the at least one sensor element (21) and a plurality of terminations at the second surface of the interconnect layer, said terminations adapted to interface with a readout substrate (38),
  - (iv) providing a readout substrate (38) having a plurality of input connections (40) disposed on a first surface thereof, said input connections (40) arranged so as to substantially correspond with the terminations at the second surface of the interconnect layer (32),
  - (v) interfacing the plurality of terminations with the corresponding input connections (40) to form an integrated assembly.
  - (vi) removing the parent substrate (10) from the integrated assembly within an area corresponding substantially with the at least one sensor element (21).
2. A method according to claim 1 wherein the step of interfacing the terminations with the corresponding input connections (40) comprises the step of forming metal connection bonds (34) there-between.
3. A method according to claim 2 wherein the metal connection bonds (34) comprise Indium metal connection bonds.
4. A method according to any of the preceding claims wherein the readout substrate (38) comprises an integrated circuit.

- 25 -

5. A method according to any of the preceding claims wherein the step of fabricating the at least one sensor element comprises the step of forming the at least one sensor element (21) on the parent substrate (10) so as to impart a crystallographic relationship there-between.
6. A method according to claim 5 wherein the step of fabricating the at least one sensor element comprises an epitaxial process such that the crystallographic structure of the parent substrate (10) is imparted to the at least one sensor element (21) during said process.
7. A method according to claim 6 wherein the parent substrate (10) exhibits a substantially single-crystal structure.
8. A method according to any of the preceding claims wherein the step of fabricating the at least one sensor element comprises a heat treatment step.
9. A method according to claim 8 wherein the heat treatment step is carried out at a temperature of at least 500°C.
10. A method according to claim 8 wherein the heat treatment step is carried out at a temperature of at least 800°C.
11. A method according to any of the preceding claims wherein the step of fabricating the at least one sensor element comprises the step of depositing onto the parent substrate (10) one of a resistive thin-film layer and a ferroelectric thin-film layer.
12. A method according to claim 11 comprising the step of depositing a multicomponent oxide thin-film layer.
13. A method according to claim 11 comprising the step of depositing a thin-film layer of colossal magnetoresistive material.

- 26 -

14. A method according to claim 11 comprising the step of depositing a thin-film layer of one of Lanthanum Barium Manganite (LBMO), Lanthanum Calcium Manganite (LCMO) and Lanthanum Strontium Calcium Manganite (LSCMO).
15. A method according to claim 11 comprising the step of depositing a thin-film layer of Lead Scandium Tantalate (PST).
16. A method according to any of claims 11 to 15 comprising the intermediate step of depositing a buffer layer onto the parent substrate (10) prior to the deposition of the thin-film layer.
17. A method according to claim 16 wherein the buffer layer comprises at least one of Strontium Titanate, Ytria-stabilised Zirconia, Cerium Oxide, Bismuth Titanate and Lanthanum Nickelate.
18. A method according to any of the preceding claims wherein the step of removing the parent substrate comprises etching the parent substrate (10) using Tetramethyl Ammonium Hydroxide (TMAH).
19. A method according to claim 18 wherein the Tetramethyl Ammonium Hydroxide etchant is doped with at least one of Silicon and Diammonium Peroxydisulphate.
20. A micro-sensor device comprising, at least one sensor element (21); an interconnect layer (32) having a first surface facing towards the at least one sensor element (21) and a second surface facing away from the at least one sensor element (21), said interconnect layer (32) having a plurality of electrical interconnections (33) between the at least one sensor element (21) and a plurality of terminations at the second surface of the interconnect layer (32); and processing means (38) disposed adjacent the second surface of the interconnect layer (32), said processing means (38) having a plurality of input connections (40) corresponding substantially with the plurality of terminations and interfaced therewith.
21. A micro-sensor device according to claim 20 comprising an array having a plurality of thermal detector sensor elements (21).

- 27 -

22. A micro-sensor device according to claim 21 wherein the thermal detector sensor elements (21) comprise at least one micro-bridge sensor element.
23. A micro-sensor device according to any of claims 20 - 22 wherein the sensor elements (21) comprise one of a ferroelectric material and a resistive material having a temperature-dependant resistivity.
24. A micro-sensor device according to claim 23 wherein the sensor elements (21) comprise a multicomponent oxide thin-film layer.
25. A micro-sensor device according to claim 23 wherein the sensor elements (21) comprise a colossal magnetoresistive thin-film layer.
26. A micro-sensor device according to claim 23 wherein the sensor elements (21) comprise one of Lanthanum Barium Manganite (LBMO), Lanthanum Calcium Manganite (LCMO) and Lanthanum Strontium Calcium Manganite (LSCMO).
27. A micro-sensor device according to claim 23 wherein the sensor elements (21) comprises Lead Scandium Tantalate.
28. A micro-sensor device according to any of claims 20 - 27 wherein the at least one sensor element (21) exhibits a substantially single-crystal structure.
29. A micro-sensor device according to any of claims 20 - 28 wherein the interconnect layer (32) is electrically non-conductive.
30. A micro-sensor device according to claim 29 wherein the interconnect layer (32) is substantially amorphous or polycrystalline.
31. A micro-sensor device according to claim 30 wherein the interconnect layer (32) comprises a dielectric material.
32. A micro-sensor device according to claim 31 wherein the interconnect layer (32) comprises silicon nitride.

- 28 -

33. A micro-sensor device according to any of claims 20 - 32 wherein the interconnect layer (32) has a thickness of less than  $100\mu\text{m}$ .
34. A micro-sensor device according to claim 33 wherein the interconnect layer (32) has a thickness of less than  $10\mu\text{m}$ .
35. A micro-sensor device according to claim 34 wherein the interconnect layer (32) has a thickness of less than  $5\mu\text{m}$ .
36. A radiation detector having a micro-sensor device according to any of claims 20 - 35.